

## USER INTERFACE SYSTEM

### CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/288,826, filed on 21 Dec. 2009, which is incorporated in its entirety by this reference.

[0002] This application is a continuation in part of prior application Ser. No. 12/497,622 filed on 3 Jul. 2009 and entitled "User Interface System and Method," which is incorporated in its entirety by this reference.

### TECHNICAL FIELD

[0003] This invention relates generally to touch sensitive user interfaces, and more specifically to an improvement of the user interface of U.S. application Ser. No. 12/497,622.

### BRIEF DESCRIPTION OF THE FIGURES

[0004] FIGS. 1*a* and 1*b* are a top view of the user interface system of a preferred embodiment and a cross-sectional view illustrating the operation of a button array in accordance to the preferred embodiments, respectively.

[0005] FIGS. 2*a*, 2*b*, and 2*c* are cross-sectional views of the retracted, extended, and user input modes of the preferred embodiments, respectively.

[0006] FIG. 3 is a cross-sectional view of the sheet, the cavity, the sensor, and the display of the preferred embodiments.

[0007] FIG. 4 is a cross-sectional view of the sheet split into a layer portion and a substrate portion.

[0008] FIGS. 5*a* and 5*b* are cross-sectional views of the sheet, the cavity, the sensor, and a displacement device that modifies the existing fluid in the cavity, with the cavity in a retracted volume setting and an expanded volume setting, respectively.

[0009] FIG. 6 is a schematic view of the sheet, the cavity, the sensor, and a displacement device of a first example that displaces additional fluid into the cavity.

[0010] FIG. 7 is a schematic view of the sheet, the cavity, the sensor, and a displacement device of a second example that displaces additional fluid into the cavity.

[0011] FIGS. 8*a* and 8*b* are schematic views of the sheet, the cavity, the sensor, and a displacement device of a third example that displaces additional fluid into and out of the cavity, with the cavity in a retracted volume setting and an expanded volume setting, respectively.

[0012] FIGS. 9, 10, 11, and 12 are top and side views of a button deformation, a slider deformation, a slider ring deformation, a guide deformation, and a pointing stick deformation, respectively.

[0013] FIG. 13 is a variation of the sensor as described in U.S. application Ser. No. 12/497,622.

[0014] FIGS. 14*a* and 14*b* are schematic views of the first and second variations of the first preferred embodiment.

[0015] FIGS. 15*a*, 15*b*, and 15*c* are schematic views of the second preferred embodiment, user input locations with

respect to the second preferred embodiment, and the method for determination of input locations in the second preferred embodiment, respectively.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The following description of the preferred embodiments of the invention is not intended to limit the invention to these preferred embodiments, but rather to enable any person skilled in the art to make and use this invention.

[0017] As shown in FIGS. 1 and 2, the user interface system 100 of the preferred embodiments includes a sheet 102 that defines a surface 115 and a fluid vessel 127, a volume of a fluid 112 contained within the fluid vessel 127, a displacement device 130 that modifies the volume of the fluid 112 to expand at least a portion of the fluid vessel 127 (thereby outwardly deforming a particular region 113 of the surface 115), and a capacitive sensor system 140 that receives a user input on the surface 115 at a first sensitivity and receives a user input substantially proximal to the particular region of the surface at a second sensitivity higher than the first sensitivity. As shown in FIG. 3, the user interface system may also include a processor 160 that functions to detect the user input and/or to evaluate the user input received by the capacitive sensor system 140. The processor 160 is preferably coupled to the capacitive sensor system 140 to receive signals from the capacitive sensor system 140. The processor 160 may also be coupled to the displacement device 130 to send signals to the displacement device 130. As shown in FIG. 3, the user interface system 100 may also include a display 150 coupled to the sheet 102 and adapted to output images to the user. In this variation, the processor 160 may also be coupled to the display 150 to control the display 150. The capacitive sensor system 140 may also be located in between the sheet 102 and the display 150 and may alternatively include a plurality of sensor components that are located in various locations within the user interface system 100. However, any other suitable arrangement of the components of the system 100 may be used. As shown in FIGS. 1*b* and 2, the fluid vessel 127 is preferably a cavity 125 and the displacement device 130 preferably influences the volume of fluid within the cavity 125 to expand and retract the cavity 125. The fluid vessel 127 may alternatively be a channel 138 or a combination of a channel 138 and a cavity 125, as shown in FIG. 4*a*. The fluid vessel 127 may also include a second cavity 125*b* that contains a volume of fluid 112 and the displacement device 130 preferably also influences the volume of the fluid within the second cavity 125*b* to expand and retract the second cavity 125*b*, thereby deforming a second particular region 113 of the surface 115. The displacement device 130 preferably influences the volume of fluid 112 within the second cavity 125*b* independently of the cavity 125, but may alternatively influence the volumes of fluid 112 within both cavity and second cavity 125 and 125*b* substantially concurrently. Alternatively, the user interface enhancement system 100 may include a second displacement device 130 that functions to influence the volume of fluid 112 within the second cavity 125*b* to expand and retract the second cavity 125*b*, thereby deforming a second particular region 113 of the surface. The second cavity 125*b* is preferably similar or identical to the cavity 125, but may alternatively be any other suitable type of cavity.

[0018] The user interface system 100 of the preferred embodiments has been specifically designed to be used as the user interface for an electronic device, more preferably in an